Method and apparatus for monitoring/calibrating a process measuring system

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Inventor: WILLIAMS PAUL (US)
Applicant: ABB IND SYSTEMS INC (US)
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GB2087544
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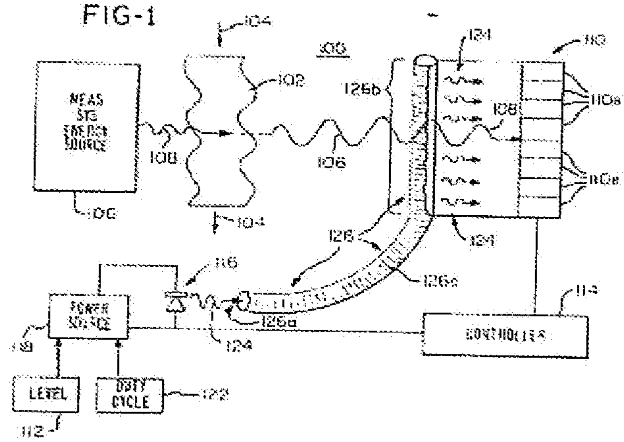
Abstract of **EP0745917**

A detector (110) of a measuring system (100) sensitive to light energy receives light (108) from a process (102) being measured and also from a separate light source (116) which is modulated such that it can be detected in signals generated by the detector (110). The separate light source (116) is turned on and off to modulate its output such that output signals from the detector (110) can be separated into on-times and off-times of the separate light source. The difference in on and off signal levels generated by the detector (110), or elements (110e) of the detector if the detector has a plurality of elements, are used to calibrate the detector (110). The light energy is conveyed to the detector (110) by an energy conduit which may be a "leaky" optical fiber (126) which receives light at one end and leaks the light out one sidewall along a portion of the fiber which is positioned adjacent to and preferably secured to the detector (110). The leaky optical fiber can be made by removing cladding (126c) from at least a portion of the sidewall along the portion of the fiber which is to leak light to the detector. Alternately, a bundle of fiber optics can be utilized with one end of the bundle receiving light and the other end being broken out to direct one or more of the fibers toward elements of the detector.

FIG-1



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(54) Method and apparatus for monitoring/calibrating a process measuring system

Verfahren und Vorrichtung zur Überwachung und Eichung einer Prozessmesseinrichtung

Procédé et dispositif de surveillance et de calibrage d'un système de mesure d'un processus

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(73) Proprietor: ABB INDUSTRIAL SYSTEMS INC.
Columbus Ohio 43202 (US)

(72) Inventor: Williams, Paul
Columbus, Ohio 43221 (US)

(74) Representative: Caldwell, Judith Margaret et al
David Keltie Associates,
12 New Fetter Lane
London EC4A 1AP (GB)

(56) References cited:
GB-A- 2 087 544
US-A- 4 289 406
US-A- 5 019 710
US-A- 5 395 027
US-A- 4 098 641
US-A- 4 767 935
US-A- 5 243 407

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Description

[0001] The present invention relates in general to the production of a web of sheet material commonly referred to as a "process" and, more particularly, to a method and apparatus for monitoring and/or calibrating a detector used in measuring one or more characteristics of the process as it is being produced.

[0002] In the art of making sheet material, such as paper, coated paper, plastics and the like, it is important to monitor various characteristics of the sheet material or process which is typically manufactured as a relatively fast moving web. Monitoring systems in turn must be monitored and frequently calibrated to provide accurate information for controlling manufacture of the process.

[0003] One currently popular form of monitoring webs of sheet material traveling in a direction referred to as the machine direction, is to physically move a monitoring gauge across the web in a direction referred to as the cross direction which is substantially perpendicular to the machine direction. For calibration purposes, movement of a scanning gauge is continued to move the gauge off the process being monitored to a position where it can be exposed to a set of standard conditions, such as a process sample having known characteristics. It is apparent that such scanning measurement ignores the majority of the web since only the material along a zig-zag line is monitored by the traveling gauge. The amount of material which is monitored is further reduced by performing off-process calibration.

[0004] In an attempt to more fully monitor a process being manufactured and to speed up web measurement and control, a stationary optical sensor extending continuously across a paper web is disclosed in U.S. Patent No. 5,071,514. As disclosed in the '514 patent, the stationary optical sensor is calibrated by a closely associated scanning optical sensor which senses discrete regions of the web as it is scanned across the web.

[0005] In this arrangement, the stationary sensor can be calibrated on-line using the scanning sensor. The scanning sensor can itself be calibrated off-line, i.e., off the process being measured, without impacting current operation of the stationary sensor. Unfortunately, provision of both a stationary sensor and a scanning sensor is very expensive and complicates the structure and operation of the overall measurement system.

[0006] GB-A-2 087 544 discloses a coating detector in which an infrared light emitting diode (LED) 1 emits narrow beam 3 to the surface of a coated web, and a reflected beam 4 is collected by a silicon phototransistor 2. The current through the LED 1 is modulated by a signal S having frequency F. GB-A-2 087 544 does not disclose any monitoring or calibration system for the coating detector.

[0007] US-A-4 767 935 discloses a system for measuring properties of travelling webs of sheet material during manufacture. The system uses two illumination devices 61 which are simultaneously modulated by rotor member 73. Light from each illumination device 61 is incident to the web 9. Pairs of photoelectric transducers 54 collect light passing through the web 9 to provide "measurement" wavelengths and "reference" wavelengths. As the "reference" wavelength is produced from the light passed through the web 9, this "reference" wavelength cannot be used for calibration of the transducers 54. Also, the two light sources in US-A-4 767 935 are both provided for the disclosed measurement system, not for monitoring and/or calibrating the measurement system.

[0008] US-A-4 098 641 discloses a method for on-line control of the opacity of a paper sheet which uses visible light emitted from a light source 37 and chopped by a chopper 39 to produce an alternating signal at detector 38 to make the signal independent of ambient light level. As this method cannot calibrate the detector, US-A-4 098 641 also discloses programmed filters 41 which are utilised for periodic off sheet standardisation to compensate for any long term drift in the sensor. However, US-A-4 098 641 does not disclose any on-line calibration of the sensor.

[0009] US-A-4 289 406 discloses calibration of an apparatus for measuring light transmission of a continuous sheet having a series of aperture patterns. The apparatus has a light pipe 22 which bypasses a portion of light emitted from a light source 12 around the sheet 16 to a sensor 14. Calibration of the system is carried out without the sheet 16 in place by measuring the sensor output when a shutter 20 blocks all of the light rays except those rays entering the fiber optic light pipe 22, and when the shutter 20 is retracted to fully expose the sensor 14. In order to normalise the transmission value associated with the pattern and in effect remove variations in the system, the system uses the output FOL which was measured where the sheet has no aperture, and the output FOL + MTL which was measured where the sheet has an aperture pattern. This normalisation method relies on the fact that the sheet cuts off all light transmission where no aperture pattern is formed. Accordingly, this method cannot be used in a paper making system.

[0010] US-A-5 019 710 discloses an optical system for detecting properties of travelling sheet materials. The system comprises a first group of bundles of optical fibers 25 and a second group of bundles of optical fibers 73. A modulating device 24 is provided to chop light emitted from light source 21 and to convey the chopped light through the optical fibers 25 to rotatable multiplexer 27 so as to distribute the chopped light to selected transmitting locations of the sheet material 9. The second group of bundles of optical fibers 73 collects and conveys light transmitted through the sheet material 9 to a light detector 23. Two wavelengths are measured and one is called a "measurement" wavelength and the other is a "reference" wavelength. As the "reference" wavelength is produced from the light passing through the sheet material 9, it cannot be used to calibrate the detector 23. US-A-5 019 710 does not disclose calibration

of the transducers.

[0011] US-A-5 243 407 discloses a device for characterising the formation of a sheet material. The device comprises a formation sensor for measuring the basis weight of the sheet material. The output of each bandpass filter of the sensor is converted to a "DC" component which is used for "normalisation" of the signal and provides sensor calibration of output. US-A-5 243 407 discloses that "the calibration could also be carried out in an "on-line" manner in situations where a separate, additional basis weight sensor is present and is measuring basis weight on (sic) the same paper being viewed by the formation sensor". However, US-A-5 243 407 does not disclose calibration of the sensor in an "on-line" manner by measuring the output of the sensor without using a separate additional sensor.

[0012] Accordingly, there is a need for an effective and inexpensive arrangement for monitoring and/or calibrating on-line process measuring systems without interrupting the collection of process data. Such a monitoring and/or calibrating arrangement is ultimately required for a commercially viable stationary, non-scanning sensor for a process monitoring system.

[0013] This need is met by the method and apparatus of the present invention wherein a detector of a measuring system sensitive to a given form of energy, such as light energy, receives energy from a process being measured and also from a separate energy source which is modulated such that it can be detected in signals generated by the detector. Preferably, the separate energy source is turned on and off to modulate its output such that output signals from the detector can be separated into times when the separate energy source was on and times when the separate energy source was off. By determining the difference in signal levels for the detector, or each element of the detector in the case of a detector having a plurality of elements, the detector can be calibrated by comparing signals generated when the separate energy source is on to signals generated when the separate energy source is off. The resulting difference signals define detector operation and are used to calibrate the detector or detector elements.

[0014] The energy level of the separate source can be made sufficiently low that when it is on it does not impact control of the process. However, it is preferred to ignore such modified signals or remove them from the data stream being used to control the process. Due to the large amounts of data which are collected in stationary, non-scanning sensors, the removal of small portions of collected data have no impact on the quality of control provided for the process.

[0015] Apparatus in accordance with the present invention includes a source of modulated power which drives an energy source for generating detector sensitive energy and an energy conduit for conveying the energy to the detector. In an illustrated embodiment of the invention, light energy is utilized and the energy conduit may comprise a "leaky" optical fiber which receives light at one end and leaks the light out one sidewall along a portion of the fiber which is positioned adjacent to and preferably secured to the detector. Such a leaky optical fiber can be made by removing cladding from at least a portion of the sidewall along the portion of the fiber which is to leak light to the detector. Alternately, a bundle of fiber optics can be utilized with one end of the bundle receiving light and the other end being broken out to direct one or more of the fibers toward each element of the detector.

[0016] In according with one aspect of the present invention, there is provided a method for measuring one or more characteristics of a process without interrupting measurement operations of the system wherein measuring system energy from a measuring system energy source is directed upon the detector for performing the measurement operations. The method is characterised by that detector sensitive energy is directed from a separate energy source which is separate from the measuring system energy source onto the detector without passage through the process. The detector sensitive energy is modulated with a defined modulation. The defined modulation is detected in measurement signals generated by the detector.

[0017] For one form of detector, the step of directing detector sensitive energy onto the detector comprises the step of illuminating the detector with light energy. Preferably, the step of modulating the detector sensitive energy comprises the step of selectively activating and deactivating a source of the detector sensitive energy. For example, the step of modulating the detector sensitive energy may comprise the step of controlling the duty cycle of the detector sensitive energy directed onto the detector, preferably to approximately 0.1 percent of the duty cycle of the energy.

[0018] The method may further comprise the steps of: determining the amplitudes of detected defined modulation; providing expected amplitudes for detected defined modulation; and comparing determined amplitudes of detected defined modulation to expected amplitudes for detected defined modulation to generate detector response signals. The detector response signals may then be used to perform the step of calibrating the detector.

[0019] In according with another aspect of the present invention, there is provided an apparatus for monitoring a detector of a system having a measuring system energy source for measuring one or more characteristics of a process without interrupting the measurement operations of the system. The apparatus is characterised by a separate energy source for generating energy of a type used in the measuring system wherein the separate energy source is separate from the measuring system energy source; a power source for driving the separate energy source; a modulator for modulating the power source; and an energy conduit for carrying energy generated by the separate energy source to the detector of the measuring system without passage through

the process while the measuring system is performing measurement operations.

[0020] Preferably, the modulator controls the output level of the power source and an on/off duty cycle of the power source; and the apparatus further comprises a controller synchronized with the modulator for accumulating output signals from the detector of the measuring system during periods of time corresponding to on-times of the power source and during periods of time corresponding to off-times of the power source.

[0021] The controller may further provide for comparing on-time accumulated output signals to off-time accumulated output signals to generate detector characteristic signals. If the detector of the measuring system comprises a plurality of detector elements, the controller accumulates the output signals for each of the detector elements to generate characteristic signals for each of the plurality of detector elements.

[0022] For light sensitive detectors, the energy source may comprise a light emitting diode (LED). In any event, where light energy is utilized, the energy conduit may comprise a fiber optic having a light receiving end positioned adjacent the light source and a light dispensing end positioned adjacent the detector, the light dispensing end comprising a length of the fiber optic having a sidewall through which light passes to impinge on the detector of the measuring system. Light passage through the sidewall can be enhanced when the fiber optic includes an outer clad by removing at least a portion of the clad along the length of the fiber optic defining the light dispensing end.

[0023] Alternately, the energy conduit may comprise a bundle of fiber optics having a light receiving end positioned adjacent the light source and a light dispensing end positioned adjacent the detector for directing light on the detector of the measuring system. Preferably, the energy conduit is secured to the detector for delivering energy generated by the energy source without interfering with measurement operations performed by the measuring system.

[0024] In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:

Fig. 1 is a schematic block diagram of a process measuring system including apparatus structured and operable in accordance with the present invention for monitoring and/or calibrating the measuring system without interrupting the system's operation;

Fig. 2 illustrates an alternate embodiment of an energy conduit for conveying modulated energy from the energy source to the detector of Fig. 1; and

Fig. 3 is a graph representing detected energy output generated by the detectors of Figs. 1 and 2 when illuminated only by the measurement system energy source and when illuminated by both the measurement system energy source and the separate energy source of the monitoring/calibrating arrangement of the present invention.

[0025] The invention of the present application will now be described with reference to Fig. 1 which schematically illustrates a stationary non-scanning system 100 for measuring one or more characteristics of a web of sheet material, commonly referred to as a process 102, as the process 102 is being manufactured. For example, the process 102 may be a web of sheet paper which is moving in the direction of the arrows 104 as it progresses from a pulp slurry at the beginning end of a paper making machine to a paper web at the finished end of the machine.

[0026] Machines for making webs of sheet material, such as paper, and stationary non-scanning systems for measuring characteristics of webs of sheet material as they are being manufactured are well known in the art and will be described herein only to the extent necessary to understand the present invention. Those desiring additional information regarding details of such machines and measuring systems are referred to U.S. Patent No. 5,071,514 which is incorporated herein by reference.

[0027] As shown in Fig. 1, the web measuring system 100 comprises a measurement system energy source 106. Energy sources used in web measuring systems range from sources of beta particles to sources of light energy selected within broad or narrow bands of light frequencies. In the embodiment illustrated in Fig. 1, the energy source 106 emits light energy 108 which passes through the process 102 and is received by a detector 110 which comprises a detector array made up of a plurality of detector elements 110e. The attenuation of the light energy 108 by the process 102 reveals characteristics of the process 102 such as basis weight, moisture content and the like which are to be measured.

[0028] The detector elements 110e of the detector 110 generate signals such as a signal 112, shown in Fig. 3, which are passed to a controller 114. The controller 114 forms part of the measuring system 100 in the illustrated embodiment and is used to process the signals received from the detector 110 to measure characteristics of the process 102 and control a machine which is making the process to maintain required process quality. In the past, such detectors have been calibrated on-line by means of a closely associated scanning optical sensor which senses discrete regions of the process 102 as it is scanned across the process 102. Unfortunately, provision of both a stationary non-scanning sensor and a scanning sensor is very expensive and complicates the structure and operation of the overall measurement system.

[0029] In accordance with the present invention, monitoring and/or calibration of the measuring system 100 is simplified by provision of a separate energy source which is modulated to provide modulated energy to the detector 110 above and beyond the energy received

from the measurement system energy source 106. The separate energy source is illustrated in Fig. 1 as a light emitting diode (LED) 116 which is driven by a power source 118, of course other energy sources can be used in the present invention. The output power level of the power source 118 is set by a level control circuit 120 which can be internal to the source 118. The power source is preferably cycled on and off to define a duty cycle of off-time to on-time which is controlled by a duty cycle circuit 122 which also can be internal to the source 118.

[0030] Light energy 124 generated by the energy source LED 116 is carried by an energy conduit to the detector 110 of the measuring system 100 while the measuring system 100 is performing measurement operations. In the illustrated embodiment of Fig. 1, the energy conduit comprises a fiber optic 126 having a light receiving end 126a positioned adjacent the LED 116 and a light dispensing end 126b positioned adjacent the detector 110. The light dispensing end 126 comprises a length of the fiber optic 126 having a sidewall through which light passes to impinge on the detector 110 of the measuring system 100.

[0031] Preferably, the fiber optic 126 includes an outer clad 126c and the length of the fiber optic 126 defining the light dispensing end 126b has at least a portion of the clad 126c removed therefrom. As illustrated in Fig. 1, the clad 126c is removed along that portion of the sidewall of the light dispensing end 126b which faces the detector 110. Alternately, as shown in Fig. 2, the energy conduit may comprise a bundle 128 of fiber optics having a light receiving end 128a positioned adjacent the LED 116 and a light dispensing end 128b positioned adjacent the detector 110 for directing light on the detector 110 of the measuring system 100.

[0032] The energy conduit, illustrated as the fiber optic 126 or the bundle 128 of fiber optics in Figs. 1 and 2 respectively, are preferably secured to the detector 110 and are positioned such that they deliver energy to the detector 110 without interfering with the energy delivered to the detector 110 from the measuring system energy source 106 after passage through the process 102. In this way, the monitoring/calibrating arrangement of the present invention can be operated during normal operation of the measuring system 100. Structural details regarding the coupling of the energy conduit to the detector 110 depend upon the particular design of the detector 110 and will not be described herein.

[0033] By controlling the duty cycle of the power source 118 via the duty cycle circuit 122, light energy 124 from the LED 116 can be added at defined intervals to the light energy 108 from the measuring system energy source 106 which has been modulated by the process 102. During periods of time that light energy 124 from the LED 116 is added, there is an energy differential Δ detectable in the signals generated by the detector 110 or each of the detector elements 110e as represented by the signal 130 in Fig. 3. In the illustrated embodiment of the invention, the controller 114 determines the energy differential Δ and is connected to the power source 118 for synchronization with the modulation of the output power from the power source 118.

[0034] As shown in Fig. 3, the differential Δ is a constant across the entire detector 110; however, it should be apparent that the actual differential Δ can vary along the length of the detector 110 or for each of the detector elements 110e. Such differences do not matter since the calibration process takes these difference into account.

[0035] In particular, the detector 110 or detector elements 110e are exposed to a series of standard conditions, such as samples of the process 102 having known characteristics, and correction factors are computed which calibrate, normalize or standardize the response or signals generated by the detector 110 or detector elements 110e. One or more of the standard conditions is illuminated by the light energy 124 from the LED 116 which can be repeated while measurements are being made by the measuring system 100. These measurements provide a measure of the response of the detector 100 or detector elements 110e such that calibration, normalization or standardization can be performed.

[0036] The continuous energy output from the separate energy source or LED 116 in combination with the energy from the measuring system energy source 106 should be less than required to saturate the detector 110 or any one of the detector elements 110e. The energy level of the separate source or LED 116 can be made sufficiently low that when it is on it does not substantially impact control of the process. However, it is preferred to ignore signals modified by input from the separate energy source or remove the modified signals from the data stream being used to control the process. Due to the large amounts of data which are collected in stationary, non-scanning sensors, the removal of small portions of collected data has no impact on the quality of control provided for the process.

[0037] Thus, signals generated by the detector 110 or detector elements 110e during the on portion of the duty cycle of the power source 118 are accumulated and signals generated during the off portion of the duty cycle are accumulated. The accumulation of signals made during the on portion of the duty cycle are compared to the accumulation of signals made during the off portion of the duty cycle to monitor and/or calibrate the detector 110 or detector elements 110e.

Claims

1. A method of monitoring a detector (110) of a system (100) for measuring one or more characteristics of a process (102) without interrupting measurement operations of the system, measuring system energy (108) from a measuring system energy source (106) being directed upon said detector for performing said measurement operations, said method being

characterized by comprising the steps of:

directing detector sensitive energy (124) from a separate energy source (116) separate from said measuring system energy source (106) onto said detector (110) without passage through said process (102);
modulating said detector sensitive energy (124) with a defined modulation; and
detecting said defined modulation in measurement signals (112, 130) generated by said detector.

2. A method as claimed in claim 1 wherein the step of directing detector sensitive energy (124) onto said detector (110) comprises the step of illuminating said detector (110) with light energy (124).

3. A method as claimed in claim 1 wherein the step of modulating said detector sensitive energy (124) comprises the step of selectively activating and deactivating a source (116) of said detector sensitive energy (124).

4. A method as claimed in claim 1 wherein the step of modulating said detector sensitive energy (124) comprises the step of controlling the duty cycle of the detector sensitive energy directed onto said detector (110).

5. A method as claimed in claim 4 wherein the step of modulating said detector sensitive energy (124) comprises the step of controlling the duty cycle of the detector sensitive energy directed onto said detector to approximately 0.1 percent of the duty cycle of said energy.

6. A method as claimed in claim 1 further comprising the steps of:

determining the amplitudes of detected defined modulation;
providing expected amplitudes for detected defined modulation; and
comparing determined amplitudes of detected defined modulation to expected amplitudes for detected defined modulation to generate detector response signals.

7. A method as claimed in claim 6 further comprising the step of calibrating said detector (110) based on said detector response signals.

8. Apparatus for monitoring a detector (110) of a system (100) having a measuring system energy source (106) for measuring one or more characteristics of a process (102) without interrupting the measurement operations of the system, said apparatus being characterised by

a separate energy source (116) for generating energy of a type used in said measuring system, said separate energy source (116) being separate from said measuring system energy source (106);
a power source (118) for driving said separate energy source (116);
a modulator (112, 122) for modulating said power source; and
an energy conduit (126, 128) for carrying energy generated by said separate energy source (116) to the detector (110) of said measuring system (100) without passage through the process (102) while said measuring system is performing measurement operations.

9. Apparatus as claimed in claim 8 wherein said energy source comprises a light emitting diode (116).

10. Apparatus as claimed in claim 8 wherein said energy source comprises a light source (116) and said energy conduit comprises a fiber optic (126) having a light receiving end (126a) positioned adjacent said light source and a light dispensing end (126b) positioned adjacent said detector (110), said light dispensing end comprising a length of said fiber optic having a sidewall through which light passes to impinge on the detector (100) of said measuring system (100).

11. Apparatus as claimed in claim 8 wherein said fiber optic (126) includes an outer clad (126c) and said length of said fiber optic defining said light dispensing end has had at least a portion of said clad removed therefrom.

12. Apparatus as claimed in claim 8 wherein said energy source comprises a light source (116) and said energy conduit comprises a bundle (128) of fiber optics having a light receiving end (128a) positioned adjacent said light source (116) and a light dispensing end (128b) positioned adjacent said detector (110) for directing light on the detector (110) of said measuring system (100).

13. Apparatus as claimed in claim 8 wherein said energy conduit (126,128) is secured to said detector (110) for delivering energy generated by said energy source (116) without interfering with measurement operations performed by said measuring system (100).

14. Apparatus as claimed in claim 8 wherein

said modulator (112,122) controls the output level of said power source (118) and an on/off

duty cycle of said power source (118); and said apparatus further comprises:
a controller (114) synchronized with said modulator (112,122) for accumulating output signals (112,130) from said detector (110) of said measuring system (100) during periods of time corresponding to on-times of said power source (116) and during periods of time corresponding to off-times of said power source (116).

15. Apparatus as claimed in claim 14 wherein said energy source comprises a light emitting diode (116).

16. Apparatus as claimed in claim 14 wherein said controller (114) further provides for comparing on-time accumulated output signals (130) to off-time accumulated output signals (112) to generate detector characteristic signals.

17. Apparatus as claimed in claim 16 wherein said detector (110) of said measuring system (100) comprises a plurality of detector elements (110e) and said controller (114) accumulates said output signals (112,130) for each of said detector elements (110e) to generate characteristic signals for each of said plurality of detector elements (110e).

18. Apparatus as claimed in claim 17 wherein said energy source comprises a light source (116) and said energy conduit comprises a fiber optic (126) having a light receiving end (126a) positioned adjacent said light source (116) and a light dispensing end (126b) positioned adjacent said detector (110), said light dispensing end (126b) comprising a length of said fiber optic (126) having a sidewall through which light passes to impinge on the detector of said measuring system.

19. Apparatus as claimed in claim 18 wherein said fiber optic (126) includes an outer clad (126c) and said length of said fiber optic defining said light dispensing end has had at least a portion of said clad removed therefrom.

20. Apparatus as claimed in claim 17 wherein said energy source comprises a light source (116) and said energy conduit comprises a bundle of fiber optics (128) having a light receiving end (128a) positioned adjacent said light source (116) and a light dispensing end (128b) positioned adjacent said detector (110) for directing light on the detector of said measuring system (100).

Patentansprüche

1. Verfahren zum Überwachen eines Detektors (110) eines Systems (100) zum Messen eines Charakteristikums oder mehrerer Charakteristika einer Materialbahn (102) ohne Unterbrechen von Meßvorgängen des Systems, wobei Systemenergie (108) von einer Meßsystem-Energiequelle (106), die auf den Detektor gerichtet wird, zum Durchführen der Meßvorgänge gemessen wird, wobei das Verfahren dadurch gekennzeichnet ist, daß es die Schritte aufweist:

   Richten von für den Detektor sensitiver Energie (124) von einer separaten Energiequelle (116), separat von der Meßsystem-Energiequelle (106), auf den Detektor (110) ohne Durchgang durch die Bahn (102);

   Modulieren der für den Detektor sensitiven Energie (124) mit einer definierten Modulation; und

   Erfassen der definierten Modulation in Meßsignalen (112, 130), erzeugt durch den Detektor.

2. Verfahren nach Anspruch 1, wobei der Schritt eines Richtens von für den Detektor sensitiver Energie (124) auf den Detektor (110) den Schritt eines Beleuchtens des Detektors (110) mit Lichtenergie (124) aufweist.

3. Verfahren nach Anspruch 1, wobei der Schritt eines Modulierens der für den Detektor sensitiven Energie (124) den Schritt eines selektiven Aktivierens und Deaktivierens einer Quelle (116) der für den Detektor sensitiven Energie (124) aufweist.

4. Verfahren nach Anspruch 1, wobei der Schritt eines Modulierens der für den Detektor sensitiven Energie (124) den Schritt eines Kontrollierens des Arbeitszyklus der für den Detektor sensitiven Energie, gerichtet auf den Detektor (110), aufweist.

5. Verfahren nach Anspruch 4, wobei der Schritt eines Modulierens der für den Detektor sensitiven Energie (124) den Schritt eines Kontrollierens des Arbeitszyklus der für den Detektor sensitiven Energie, gerichtet auf den Detektor, auf ungefähr 0,1 Prozent des Arbeitszyklus der Energie aufweist.

6. Verfahren nach Anspruch 1, das weiterhin die Schritte aufweist:

   Bestimmen der Amplituden einer erfaßten, definierten Modulation;

   Liefern von erwarteten Amplituden für eine erfaßte, definierte Modulation; und

   Vergleichen bestimmter Amplituden einer erfaßten, definierten Modulation mit erwarteten

Amplituden für eine erfaßte, definierte Modulation, um Detektoransprechsignale zu erzeugen.

7. Verfahren nach Anspruch 6, das weiterhin den Schritt eines Kalibrierens des Detektors (110) basierend auf den Detektoransprechsignalen aufweist.

8. Vorrichtung zum Überwachen eines Detektors (110) eines Systems (100), das eine Meßsystem-Energiequelle (106) zum Messen eines Charakteristikums oder mehrerer Charakteristika einer Materialbahn (102) ohne Unterbrechen der Meßvorgänge des Systems besitzt, wobei die Vorrichtung gekennzeichnet ist durch

eine separate Energiequelle (116) zum Erzeugen von Energie eines Typs, der in dem Meßsystem verwendet wird, wobei die separate Energiequelle (116) separat von der Meßsystem-Energiequelle (106) vorliegt;

eine Energiequelle (118) zum Ansteuern der separaten Energiequelle (116);

einen Modulator (112, 122) zum Modulieren der Energiequelle; und

einen Energiekanal (126, 128) zum Führen von Energie, die durch die separate Energiequelle (116) erzeugt ist, zu dem Detektor (110) des Meßsystems (100) ohne Durchgang durch die Bahn (102), während das Meßsystem Meßvorgänge durchführt.

9. Vorrichtung nach Anspruch 8, wobei die Energiequelle eine Licht emittierende Diode (116) aufweist.

10. Vorrichtung nach Anspruch 8, wobei die Energiequelle eine Lichtquelle (116) aufweist und der Energiekanal eine Faseroptik (126) aufweist, die ein Licht aufnehmendes Ende (120a), positioniert angrenzend an die Lichtquelle, und ein Licht verteilendes Ende (126b), positioniert angrenzend an den Detektor (110), aufweist, wobei das das Licht verteilende Ende eine Länge der Faseroptik aufweist, die eine Seitenwand besitzt, durch die Licht hindurchführt, um auf den Detektor (110) des Meßsystems (100) aufzutreffen.

11. Vorrichtung nach Anspruch 8, wobei die Faseroptik (126) einen äußeren Mantel (126c) umfaßt und die Länge der Faseroptik, die das Licht verteilende Ende definiert, mindestens einen Bereich besitzt, von dem der Mantel entfernt ist.

12. Vorrichtung nach Anspruch 8, wobei die Energiequelle eine Lichtquelle (116) aufweist und der Energiekanal ein Bündel (128) aus Faseroptiken aufweist, das ein Licht aufnehmendes Ende (128a), positioniert angrenzend an die Lichtquelle (116), und ein Licht verteilendes Ende (128b), positioniert angrenzend an den Detektor (110), zum Richten von Licht auf den Detektor (110) des Meßsystems (100) besitzt.

13. Vorrichtung nach Anspruch 8, wobei der Energiekanal (126, 128) an dem Detektor (110) zum Zuführen von Energie, erzeugt durch die Energiequelle (116), ohne Beeinflussen der Meßvorgänge, durchgeführt durch das Meßsystem (100), befestigt ist.

14. Vorrichtung nach Anspruch 8, wobei der Modulator (112, 122) das Ausgangsniveau der Energiequelle (118) und einen Ein-/Aus-Arbeitszyklus der Energiequelle (118) steuert, und

die Vorrichtung weiterhin aufweist:

eine Steuereinheit (114), synchronisiert zu dem Modulator (112, 122), zum Akkumulieren von Ausgangssignalen (112, 130) von dem Detektor (110) des Meßsystems (100) während Zeitperioden entsprechend zu Einschaltzeiten der Energiequelle (116) und während Zeitperioden entsprechend zu Ausschaltzeiten der Energiequelle (116).

15. Vorrichtung nach Anspruch 14, wobei die Energiequelle eine Licht emittierende Diode (116) aufweist.

16. Vorrichtung nach Anspruch 14, wobei die Steuereinheit (114) weiterhin zum Vergleichen von akkumulierten Einschaltzeiten-Ausgangssignalen (130) zu akkumulierten Ausschaltzeiten-Ausgangssignalen (112) dient, um Detektor-Charakteristikum-Signale zu erzeugen.

17. Vorrichtung nach Anspruch 16, wobei der Detektor (110) des Meßsystems (100) eine Vielzahl von Detektorelementen (110e) aufweist und die Steuereinheit (114) die Ausgangssignale (112, 130) für jedes der Detektorelemente (110e) akkumuliert, um Charakteristikum-Signale für jedes der Vielzahl der Detektorelemente (110e) zu erzeugen.

18. Vorrichtung nach Anspruch 17, wobei die Energiequelle eine Lichtquelle (116) aufweist und der Energiekanal eine Faseroptik (126) aufweist, die ein Licht aufnehmendes Ende (126a), positioniert angrenzend an die Lichtquelle (116), und ein Licht verteilendes Ende (126b), positioniert angrenzend an den Detektor (110), aufweist, wobei das Licht verteilende Ende (126b) eine Länge der Faseroptik (126) aufweist, die eine Seitenwand besitzt, durch

die Licht hindurchführt, um auf den Detektor des Meßsystems aufzutreffen.

19. Vorrichtung nach Anspruch 18, wobei die Faseroptik (126) einen äußeren Mantel (126c) aufweist und die Länge der Faseroptik, die das Licht verteilende Ende definiert, mindestens einen Bereich, von dem der Mantel entfernt ist, besitzt.

20. Vorrichtung nach Anspruch 17, wobei die Energiequelle eine Lichtquelle (116) aufweist und der Energiekanal ein Bündel aus Faseroptiken (128) aufweist, das ein Licht aufnehmendes Ende (128a), positioniert angrenzend an die Lichtquelle (116), und ein Licht verteilendes Ende (128b), positioniert angrenzend an den Detektor (110), zum Richten von Licht auf den Detektor des Meßsystems (100), besitzt.

Revendications

1. Procédé pour contrôler un détecteur (110) faisant partie d'un système (100) destiné à mesurer une ou plusieurs caractéristiques d'un élément à traiter (102) sans interrompre les opérations de mesure du système, à mesurer l'énergie du système (108) provenant d'une source d'énergie du système de mesure (106) dirigée sur ledit détecteur afin de réaliser lesdites opérations de mesure, ledit procédé étant caractérisé en ce qu'il comprend les étapes consistant à :

   diriger l'énergie activant le détecteur (124) à partir d'une source d'énergie distincte (116) dissociée de ladite source d'énergie du système de mesure (106) sur ledit détecteur (110) sans traverser ledit élément à traiter (102) ;
   moduler ladite énergie activant le détecteur (124) avec une modulation définie ; et
   détecter ladite modulation définie dans les signaux de mesure (112, 130) générés par ledit détecteur.

2. Procédé selon la revendication 1, dans lequel l'étape consistant à diriger l'énergie activant le détecteur (124) sur ledit détecteur (110) comprend l'étape consistant à éclairer ledit détecteur (110) par une énergie lumineuse (124).

3. Procédé selon la revendication 1, dans lequel l'étape consistant à moduler ladite énergie activant le détecteur (124) comprend l'étape consistant à activer et à désactiver de manière sélective une source (116) de ladite énergie activant le détecteur (124).

4. Procédé selon la revendication 1, dans lequel l'étape consistant à moduler ladite énergie activant le détecteur (124) comprend l'étape consistant à contrôler le cycle opératoire de l'énergie activant le détecteur dirigée sur ledit détecteur (110).

5. Procédé selon la revendication 4, dans lequel l'étape consistant à moduler ladite énergie activant le détecteur (124) comprend l'étape consistant à contrôler le cycle opératoire de l'énergie activant le détecteur dirigée sur ledit détecteur à environ 0,1 % du cycle opératoire de ladite énergie.

6. Procédé selon la revendication 1, comprenant en outre l'étape consistant à :

   déterminer les amplitudes de la modulation définie détectée ;
   fournir les amplitudes prévues pour la modulation définie détectée ; et
   comparer les amplitudes déterminées de la modulation définie détectée aux amplitudes prévues pour la modulation définie détectée afin de générer des signaux de réponse du détecteur.

7. Procédé selon la revendication 6, comprenant en outre l'étape consistant à étalonner ledit détecteur (110) en se basant sur lesdits signaux de réponse du détecteur.

8. Appareil pour contrôler un détecteur (110) d'un système (100) ayant une source d'énergie du système de mesure (106) afin de mesurer une ou plusieurs caractéristiques d'un élément à traiter (102) sans interrompre les opérations de mesure du système, ledit appareil étant caractérisé par :

   une source d'énergie distincte (116) pour générer une énergie d'un type utilisé dans ledit système de mesure, ladite source d'énergie distincte (116) étant dissociée de ladite source d'énergie du système de mesure (106) ;
   une source d'alimentation (118) pour exciter ladite source d'énergie distincte (116) ;
   un modulateur (112, 122) pour moduler ladite source d'alimentation ; et
   un tube de transport d'énergie (126, 128) pour acheminer l'énergie générée par ladite source d'énergie distincte (116) vers le détecteur (110) dudit système de mesure (100) sans traverser l'élément à traiter (102) tandis que ledit système de mesure effectue les opérations de mesure.

9. Appareil selon la revendication 8, dans lequel ladite source d'énergie comprend une diode électroluminescente (116).

10. Appareil selon la revendication 8, dans lequel ladite

source d'énergie comprend une source de lumière (116) et ledit tube de transport d'énergie comprend une fibre optique (126) ayant une extrémité recevant la lumière (126a) placée à proximité de ladite source de lumière et une extrémité distribuant la lumière (126b) placée à proximité dudit détecteur (110), ladite extrémité distribuant la lumière comprenant une certaine longueur de ladite fibre optique ayant une paroi latérale à travers laquelle passe la lumière pour atteindre le détecteur (110) dudit système de mesure (100).

11. Appareil selon la revendication 8, dans lequel ladite fibre optique (126) comprend un revêtement extérieur (126c) et ladite longueur de ladite fibre optique définissant ladite extrémité distribuant la lumière a au moins une partie dudit revêtement qui en est retirée.

12. Appareil selon la revendication 8, dans lequel ladite source d'énergie comprend une source de lumière (116) et ledit tube de transport d'énergie comprend un faisceau (128) de fibres optiques ayant une extrémité recevant la lumière (128a) placée à proximité de ladite source de lumière (116) et une extrémité distribuant la lumière (128b) placée adjacente audit détecteur (110) pour diriger la lumière sur le détecteur (110) dudit système de mesure (100).

13. Appareil selon la revendication 8, dans lequel ledit tube de transport d'énergie (126, 128) est fixé audit détecteur (110) pour délivrer l'énergie générée par ladite source d'énergie (116) sans perturber les opérations effectuées par ledit système de mesure (100).

14. Appareil selon la revendication 8, dans lequel

ledit modulateur (112, 122) contrôle le niveau de sortie de ladite source d'alimentation (118) et un cycle opératoire de marche/arrêt de ladite source d'alimentation (118) ; et
ledit appareil comprend en outre :
un régulateur (114) synchronisé avec ledit modulateur (112, 122) pour accumuler les signaux de sortie (112, 130) à partir dudit détecteur (110) dudit système de mesure (100) au cours de périodes correspondant aux périodes de fonctionnement de ladite source d'alimentation (116) et pendant des périodes correspondant aux périodes d'arrêt de ladite source d'alimentation (116).

15. Appareil selon la revendication 14, dans lequel ladite source d'énergie comprend une diode électroluminescente (116).

16. Appareil selon la revendication 14, dans lequel ledit régulateur (114) effectue en outre une comparaison des signaux de sortie accumulés en fonctionnement (130) avec les signaux de sortie accumulés à l'arrêt (112) pour générer des signaux caractéristiques du détecteur.

17. Appareil selon la revendication 16, dans lequel ledit détecteur (110) dudit système de mesure (100) comprend une pluralité d'éléments de détecteur (110e) et ledit régulateur (114) accumule lesdits signaux de sortie (112, 130) pour chacun desdits éléments de détecteur (110e) afin de générer des signaux caractéristiques pour chaque éléments inclus dans ladite pluralité d'éléments de détecteur (110e).

18. Appareil selon la revendication 17, dans lequel ladite source d'énergie comprend une source de lumière (116) et ledit tube de transport d'énergie comprend une fibre optique (126) ayant une extrémité recevant la lumière (126a) placée à proximité de ladite source de lumière (116) et une extrémité distribuant la lumière (126b) placée à proximité dudit détecteur (110), ladite extrémité distribuant la lumière (126b) comprenant une certaine longueur de ladite fibre optique (126) ayant une paroi latérale à travers laquelle la lumière passe afin d'atteindre le détecteur dudit système de mesure.

19. Appareil selon la revendication 18, dans lequel ladite fibre optique (126) comprend un revêtement extérieur (126c) et ladite longueur de ladite fibre optique définissant ladite extrémité distribuant la lumière a au moins une partie dudit revêtement qui en est retirée.

20. Appareil selon la revendication 17, dans lequel ladite source d'énergie comprend une source de lumière (116) et ledit tube de transport d'énergie comprend un faisceau de fibres optiques (128) ayant une extrémité recevant la lumière (128a) placée à proximité de ladite source de lumière (116) et une extrémité distribuant la lumière (128b) placée à proximité dudit détecteur (110) pour diriger la lumière sur le détecteur dudit système de mesure (100).

FIG-1

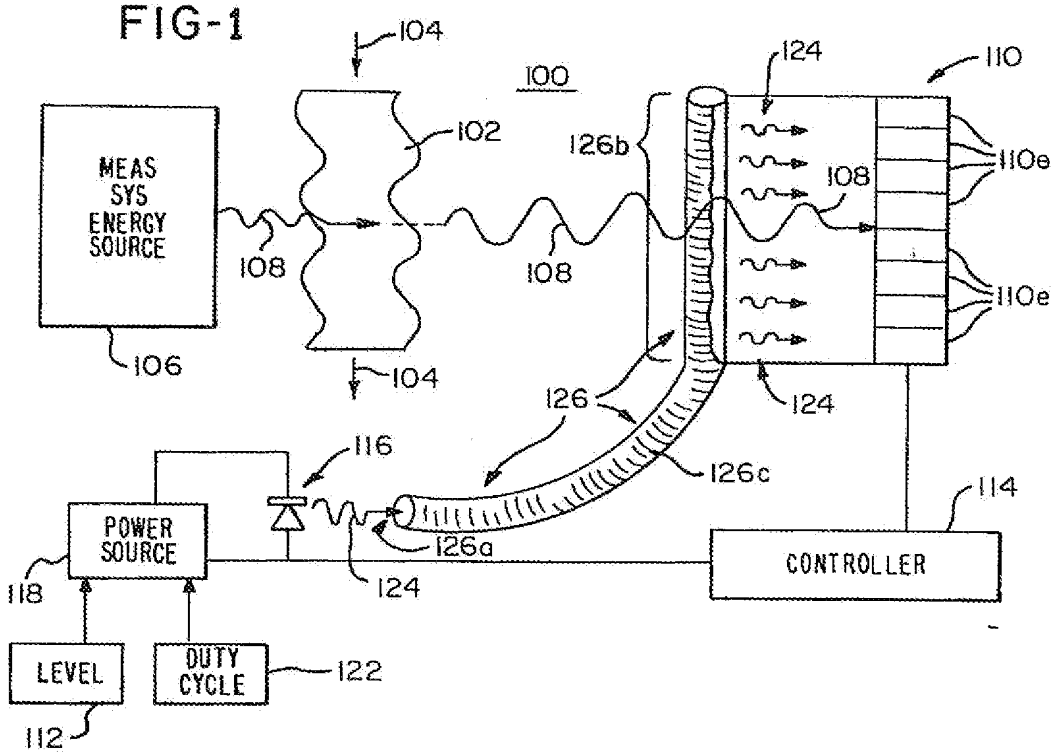

FIG-3

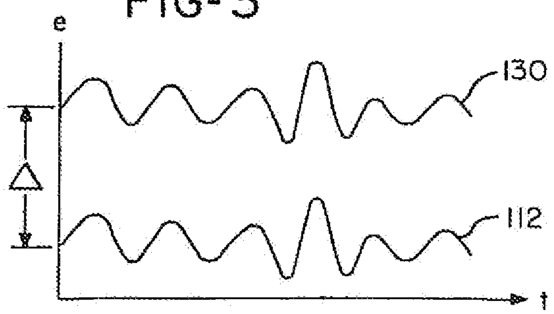

FIG-2